Advancing GPCP Products to Version 3.2

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GPCP Version 3.2 has been developed under the NASA Making Earth Science Data Records for Use in Research Environments (MEaSUREs) program

Also see:

36th Hydrol. Poster R130: The Latest GPCP Monthly and Daily Products and High-Latitude Considerations.
Behrangi, Huffman, Adler, Bolvin, Nelkin, Gu, and Ehsani

Trenberth Symposium 4.4: Global Precipitation Means and Variations: The New Version of GPCP.
Adler, Gu, Huffman, Behrangi, Bolvin, Wang, Nelkin

1. GPCP V3 – Design (1/2)

Build on GPCP Version 1 and Version 2 heritage with

- finer spatial resolution
- stronger quality control and validation
- better treatment of the high latitudes
  - revised TOVS/AIRS intercalibration
  - revised gauge undercatch correction (work in progress)
- next-generation uncertainty estimates (work in progress)
- precipitation phase estimates

As a Climate Data Record (CDR)-like data set, we need

- consistent inputs
- careful inter-sensor calibration
- consistent processing over the entire record

1. GPCP V3 – Design (2/2)

Input datasets for the Monthly product

- GPROF SSMI / SSMIS – Kummerow (Colorado State Univ.)
- METH SSMI / SSMIS – Chiu (George Mason Univ.)
- PERSIANN CDR – Hsu (Univ. of California Irvine)
  - computed with GridSat GEO-IR Tb dataset at 10 km, 3 hr resolution – Knapp (NOAA/NCEI)
- TOVS/AIRS-IR – Susskind (NASA/GSFC)
- precipitation gauge analysis – Becker (Global Precipitation Climatology Centre [GPCC]; Deutscher Wetterdienst)
- TRMM Composite Climatology (TCC) – Adler (Univ. of Maryland)
- Merged CloudSat/TRMM/GPM climatology (MCTG) – Behrangi (Univ. of Arizona)

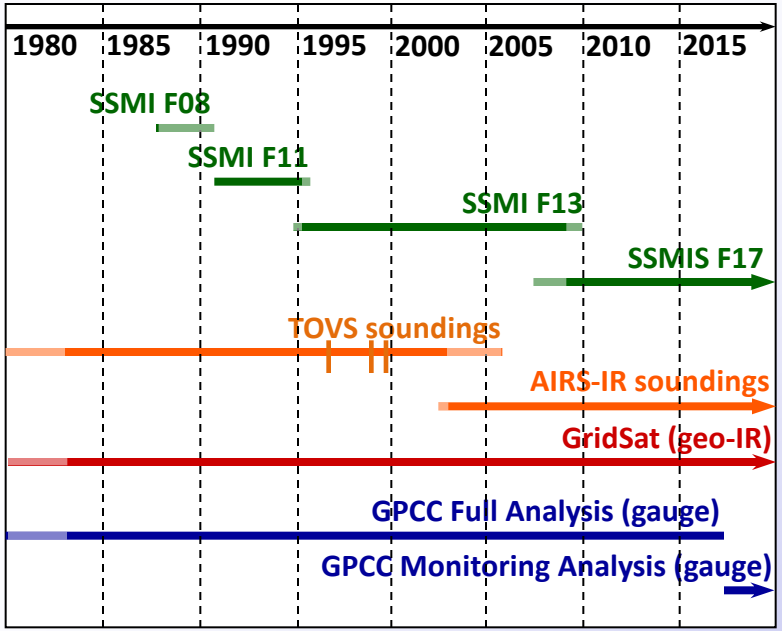
1. GPCP V3 – Monthly Product Inputs

The inputs and algorithms used are:

- SSMI, SSMIS: GPROF2010V2, METH
  - only a single 6 a.m./p.m. satellite is used at a time to avoid varying time-of-day biases
- TOVS, AIRS-IR: Susskind cloud volume
- GridSat: PERSIANN CDR
  - PERSIANN CDR is scaled to GPCP V2.3

GPCC gauge analysis:

- Full Product as far as it reaches
- Monitoring Product thereafter
- undercatch-adjusted with blended Legates-Wilmott and Fuchs monthly climatological coefficients

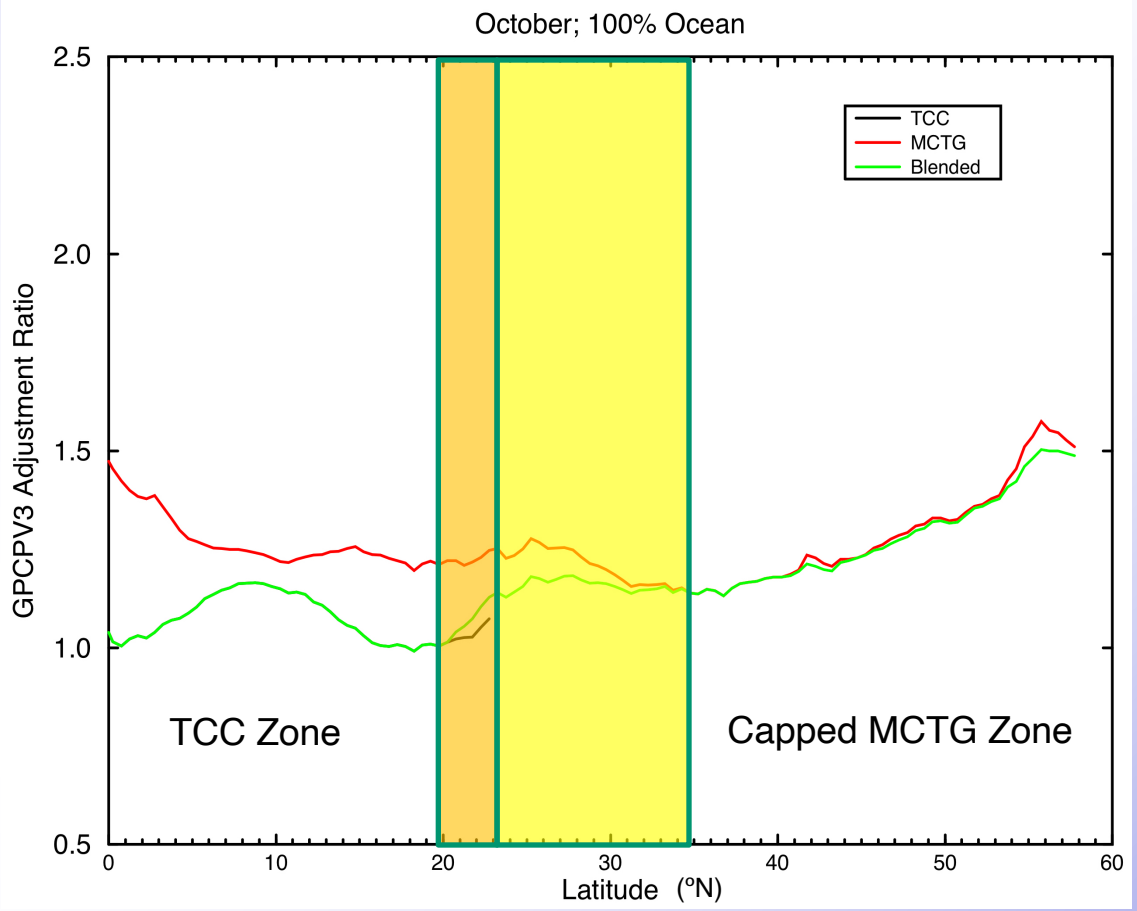


1. GPCP V3 – TCC / MCTG Ratio Blending Scheme

Apply climatologies based on shorter records:

- TCC at low latitudes
- MCTG at middle and high latitudes

TCC and MCTG don't quite match in the transition zone, so we blend across the zone 20°-35° N and S



1. GPCP V3 – Monthly Data Field Computations

Precipitation

- 58ºN-S
  - 1992-present: PERSIANN CDR histogram-adjusted using GPROF at the 3-hourly scale, calibrated to monthly METH, then calibrated with TCC/MCTG climatology blend
  - 1983-1991: PERSIANN CDR adjusted using monthly climatological (1993-2008) GPROF relationship
- higher latitudes
  - calibrated TOVS/AIRS-IR (globally) adjusted to the MCTG

Precipitation error computed as in GPCP V2 (Huffman 1997)

Precipitation phase

- specification of liquid phase from Sims and Liu (2015)
- uses MERRA-2 reanalysis surface T, RH, pressure

Quality Index

- “equivalent gauges” computed from error (Huffman 1997)

1. GPCP V3.2 – Monthly Product Data Files and Fields

NetCDF with extensive metadata

- monthly January 1983 – December 2020 (currently)
- global 0.5º x 0.5º lat./lon. grid
- DOI:10.5067/MEASURES/GPCP/DATA304 (activated “soon”)

8 data fields

- merged satellite-gauge precipitation estimate (mm/d)
- merged satellite-gauge precipitation random error estimate (mm/d)
- satellite-only precipitation estimate (mm/d)
- satellite source field (IR, IR/TOVS/AIRS blend, TOVS/AIRS)
- undercatch-corrected gauge analysis precipitation (mm/d)
- probability of liquid phase (%)
  - only 60º N-S before 1992
- gauge relative weighting
- Quality Index (equiv. gauges)

1. GPCP V3.2 – Summary of Upgrades from V2.3 Monthly

- consistent GEO-IR Tb datasets, expanded from 40^{o} N-S to 60^{o} N-S
- upgraded PMW and IR algorithms
- consistent AIRS-IR record
- shifted from calibration of AIRS-to-TOVS to improved TOVS-to-AIRS-IR
- added modern climatological calibrators (TCC over 20^{o} N-S, MCTG outside 35^{o} N-S, blended cross-over in between)
- new data fields: probability of liquid phase, Gauge Relative Weighting, Quality Index
- substitute Fuchs gauge undercatch coefficients for Legates-Wilmott over Eurasia (above 45^{o} N)

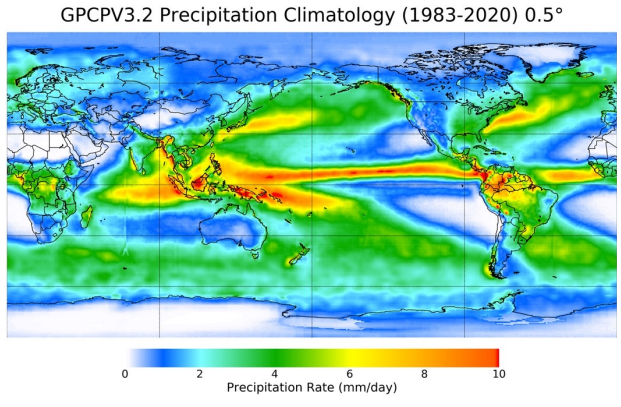
1. GPCP V3.2 – Climatology

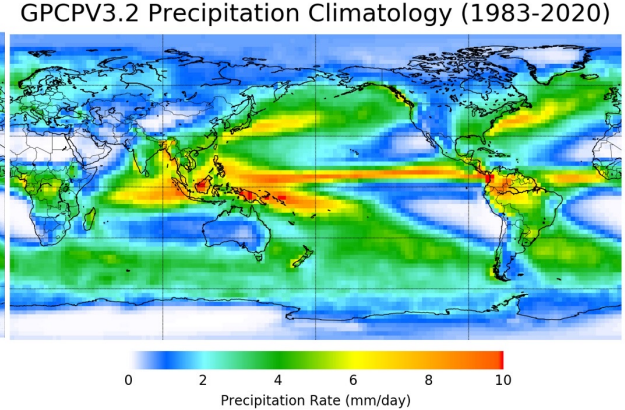
Gauges tend to dominate land areas in both 2.3 and 3.2

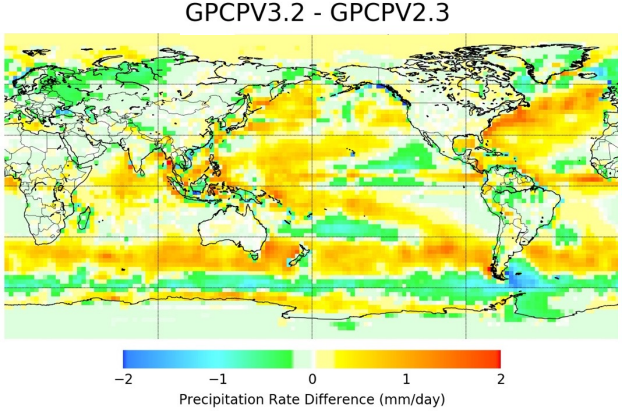
3.2 tends to be higher over oceans

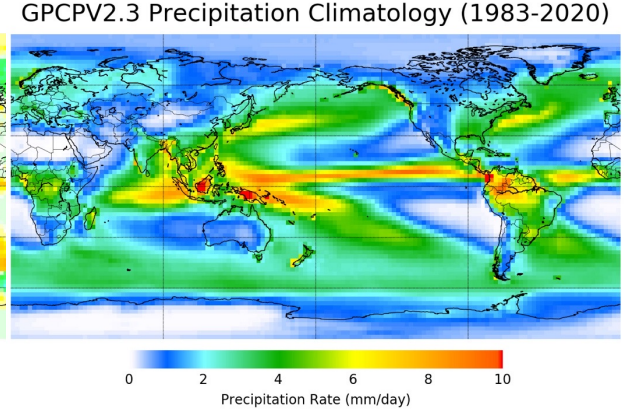
- largest increases in storm tracks
- decrease around 60ºS in 3.2 improves a perceived 2.3 issue
- increase in polar regions driven by CloudSat (in MCTG)

Full-resolution 3.2 (top left) shows some artifacts due to the IR in the Indian and Atlantic Oceans









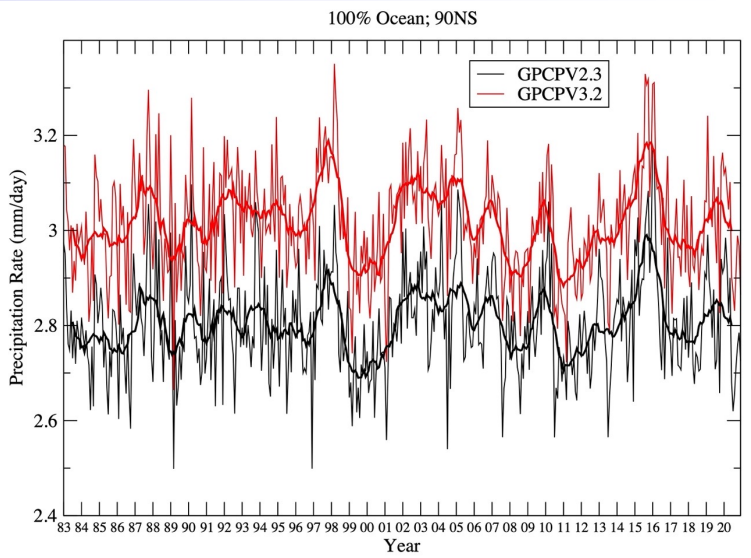
[D. Bolvin (SSAI; GSFC)]

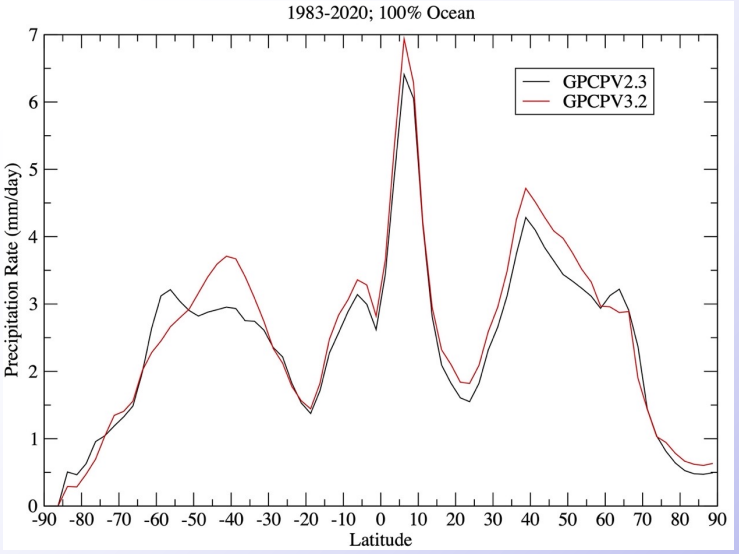
1. GPCP V3.2 – Climatology

The global ocean time series for 3.2 largely matches that of 2.3 but is higher

- interannual variation in the tropics is governed by METH in both
- calibration by TCC and MCTG sets the mean increase in 3.2

The zonal profiles are similar, with the biggest difference in the Southern Ocean considered an improvement in 3.2





[D. Bolvin (SSAI; GSFC)]

2. GPCP V3.2 – Daily Product Approach

The inputs are:

- Integrated Multi-satellitE Retrievals for GPM (IMERG)
- TOVS, AIRS-IR daily: Susskind cloud volume
- GPCP V3.2 Monthly

Approach:

- average IMERG (originally 0.1°, ½ hr) up to 0.5° daily
- histogram-calibrate TOVS, AIRS-IR to IMERG
- use IMERG in the band 55° N-S and IMERG-calibrated TOVS/AIRS at higher latitudes
  - this is done for simplicity; future versions will use IMERG at all latitudes
- "feather" the IMERG-AIRS difference just outside 55° to reduce seams
- scale the Daily to (approximately) sum to the Monthly product

2. GPCP V3.2 – Daily Product Data Files and Fields

NetCDF with extensive metadata

- daily June 2000 – December 2020 (currently)
- global 0.5º x 0.5º lat./lon. grid

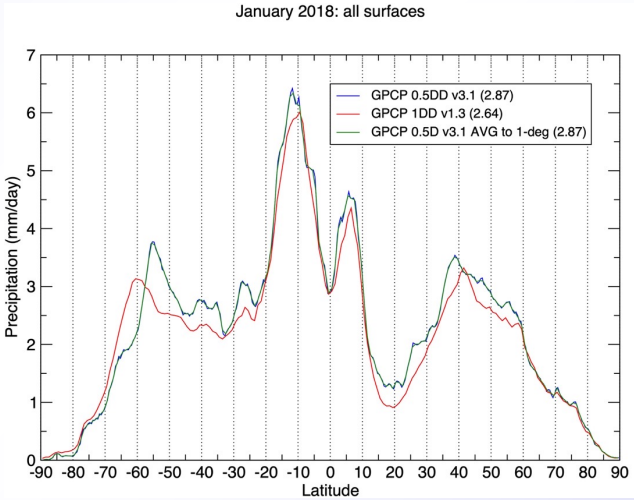
2 data fields

- satellite precipitation estimate (mm/d)
- probability of liquid phase (%)

2. GPCP V3.2 – Daily Product for January 2018

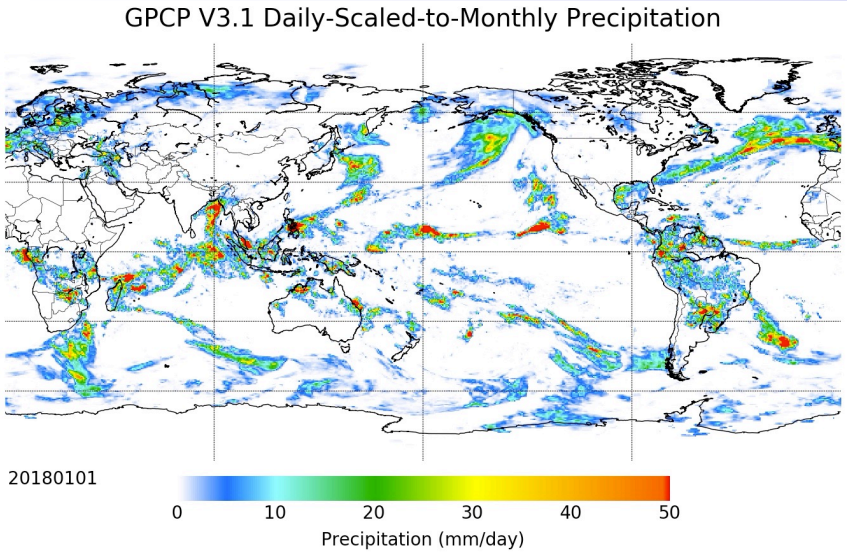
The zonal profile for this month is similar to the current One-Degree Daily (1DD)

- the overall bias in each is controlled by its corresponding Monthly product
- V3.2 Daily's finer grid allows more-detailed variation



Daily maps tend to have good continuity across the 55° N,S boundaries

- heavier feathering would improve day-to-day seams, but drives unrealistic changes in fractional coverage in the affected zones



[E. Nelkin (SSAI; GSFC)]

3. Final Comments

GPCP Version 3.2 is designed for

- new satellite retrievals
- higher user expectations
- upgrades in dataset formats and archiving
- continued CDR standards

Monthly and daily datasets are ready to be posted at GES DISC

- by design, submonthly (approximately) add up to the monthly values
- documentation is being finalized
- V3.2 monthly DOI: 10.5067/MEASURES/GPCP/DATA304
- V3.2 daily DOI: 10.5067/MEASURES/GPCP/DATA305